DOCUMENT RESUME

ED 279 416 PS 016 366

AUTHOR Kalyan-Masih, V.
TITLE Cognitive Development of Rural Preschool Children.
PUB DATE Jul 86
NOTE 25p.; Paper presented at the World Organization for Early Childhood Education World Congress (18th, Jerusalem, Israel, July 13-17, 1986).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Classification; *Cognitive Development; *Conservation (Concept); Construct Validity; Developmental Stages; Longitudinal Studies; *Preschool Children; Preschool Education; *Rural Areas; *Serial Ordering
IDENTIFIERS *Nebraska; Nebraska Wisconsin Cognitive Assessment Battery; Piagetian Tasks

ABSTRACT

A 3-year longitudinal study assessed cognitive changes among rural children 3 to 5 years old and validated the construct validity of the Nebraska Wisconsin Cognitive Assessment Battery (NEWCAB). Multistage area sampling techniques were used with a repeated measures, control group design. Participants in the sample were 40 3-year-olds, 57 4-year-olds, and 75 5-year-olds. All children came from intact two-parent families who derived some income from a farm of at least 10 acres and who had lived on a farm for at least 5 years prior to the study. Control subjects were used to check the effects of repeated testing with the NEWCAB. Consisting of 16 mostly Piagetian tasks that were differentially assigned according to age and difficulty levels to each of three sections, the NEWCAB assessed children's cognitive development in the areas of Relations, Classification, and Number and Length. Findings indicated that group means as well as the percentage of children attaining success increased significantly across 3 years. Outcomes of factor analyses supported the construct validity of the NEWCAB for preschool children. It is concluded that the rural setting seemed conducive to the normal cognitive development of children. (RH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED279416

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Cognitive Development of Rural Preschool Children

by

V. Kalyan-Masih, Ph.D.
University of Nebraska
Lincoln, NE, USA

18th World Congress of O.M.E.P.

Jerusalem, Israel

July 13-17, 1986

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

V. Kalyan-Masih

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Address:
144 Ruth Staples Child Development Lab
University of Nebraska-Lincoln
East Campus
Lincoln, NE 68583-0809

PS 016366

BEST COPY AVAILABLE

Acknowledgements

Development of this instrument was funded by Nebraska Agricultural Experiment Station, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln and Wisconsin Agricultural Experiment Station, University of Wisconsin-Madison, as part of the North Central 124 Regional Project.

©Copyright, 1980 Board of Regents, University of Nebraska-Lincoln, and Board of Regents, University of Wisconsin-Madison. All rights reserved.

Cognitive Development of Rural Preschool Children

by

V. Kalyan-Masih, Ph.D., University of Nebraska
Lincoln, NE USA

Several midwestern states of USA participated in a three-year longitudinal regional research project, NC-124: Life Span Analysis of Mental and Social Development of Rural Children. Nebraska was one of the eight participating states. Though the data were collected on 3-11 year old children, by all participating states this paper will report findings from the Nebraska data on 3-5 year old rural children. The objectives of this study was to investigate cognitive changes across three years and to validate the construct validity of NEWCAB for 3-5 year olds.

Methodology

1. Design and Sampling Procedures

A repeated measure three year longitudinal design was used. Nebraska added control cohorts at the 2nd and 3rd testing to check for repeated test effects.

Multistage area sampling techniques were used for selecting the Nebraska subjects. Initial stratification of the state was accomplished by adopting the six regions established by the legislature for state agency planning purposes. Intitially, twelve counties (two from each

region) were randomly selected. Because of the sparse population in western Nebraska, two additional counties were randomly drawn from each of the two regions in that part of the state bringing the total number of counties participating to 16. Four-square-mile segments were randomly drawn from these selected counties. Families participating in the study lived in these selected segments.

Home Extension personnel and UNL students from the selected counties assisted in providing names of the families living in the selected segments.

2. Sample

The Nebraska total sample consisted of 40 3-year olds with an age range of 3 years, 0 months through 3 years, 6 months; 57 4-year olds with an age range of 3 years, 11 months through 4 years, 5 months; and 75 5-year olds with an age range of 4 years, 11 months through 5 years and 5 months.

All children came from intact two-parent families who derived some income from their farm of at least ten acres and who had lived on a farm for at least five years prior to the study. Children with obvious handicaps were not included in the study. Thus the Nebraska sample met the NC-124 defined criteria of representative randomness

with stratification for ruralness, residence, farm derived income, and intact families.

Insert Table 1 About Here

Initially 40 3-year olds were tested the first year. Thirty six of these at age four were tested the second year along with 21 4-year old control cohorts added to the sample. These 57 children were tested the third year at age 5 along with 20 5-year old control cohorts added to the sample. Some children were tested only once (20 5-year old control cohorts added the third year of testing). Some were tested two times (21 4-year old control cohorts added the second year). Some were tested three times (40 3-year olds selected the first year). Since the same assessment measures were used, repeated test effects were checked by adding the control cohorts the second and the third year of testing. Table 1 illustrates further these details: the year of assessment, the year of entry in the sample, and continuity of subgroups in the sample.

3. Assessment Measures:

The Nebraska Wisconsin Cognitive Assessment Battery (NEWCAB).

After pilot testing, procedural modifications were refined and scoring protocols were expanded. The battery went through three revisions before the present standardized format was devised as a result of the joint efforts of Nebraska (V. Kalyan-Masih) and Wisconsin (W. Marshall) scientists participating in this study.

The NEWCAB consists of:

1. The NEWCAB Manual. The 79-page manual contains: purpose of the cognitive task, description of testing materials, standardized instructions for administering and scoring, and suggestions for interpreting the scores for each of the 16 tasks included in the battery.
2. The NEWCAB Testing Kit. A small cardboard box containing toy type testing materials such as cardboard trees, pots, wooden hurdles, plastic chips, etc.

The primary consideration in developing the NEWCAB was that the selected Piagetian tasks should provide a valid measure of cognitive structures selected for study and that the assessment materials be appealing to children and easy for

them to handle. All the tasks in the battery are modified versions of original Piagetian tasks and/or derived from the theory.

There are three sections in the NEWCAB reflecting three selected aspects of cognitive functioning: Relations, Classification, and Number and Length. The NEWCAB is comprised of a total of 16 tasks differentially assigned to the three sections. Within each section these 16 tasks are arranged in an ascending order of difficulty (easiest for the younger child and more difficult for the older). The assignment of tasks according to difficulty and age levels reflects the Piagetian framework.

Validity

Three kinds of validity have been suggested in The Standards for Educational and Psychological Tests and Manuals (French and Michael, 1966): content validity, criterion-related validity, and construct validity. Since the NEWCAB is derived from the Piagetian theory the claim for its validity is essentially of the "construct validity" type. Criterion-related validity may also be considered by correlating the performance on NEWCAB with one external criterion: the Peabody Picture Vocabulary Test.

Construct-Validity

Construct-validity refers to the degree to which performance scores may be explained by theoretical assumptions and constructs of a theory. The basic theoretical assumptions of the NEWCAB are:

1. That cognitive changes proceed in an orderly sequence.
2. That cognitive changes are qualitative rather than quantitative.
3. That these cognitive (structural) changes may be inferred from differential performance on cognitive tasks.
4. That these structural changes do not remain isolated but are integrated and coordinated into higher order structures which in turn permit cognitive functioning at a higher level.

Let us consider Relations task #1 which is designed to assess how a child seriates seven graduated cardboard trees. One of the following behavior sequences may be noted and scored accordingly.

1. Child plays with trees, may choose any tree in front of him.
2. Child finds a big/small tree from any two of the seven trees.

3. Child finds the biggest-smallest of the seven trees.
4. Child makes short discrete series with two or three trees.
5. Child makes short continuous series with 3 to 5 trees.
6. Child seriates seven trees but by trial-and-error (changes position of three or more trees).
7. Child seriates seven trees spontaneously (may change position of one or two trees only).

A child who cannot find the biggest/smallest of the seven trees (it is not a question of not understanding the language) is assumed not to be able to seriate even five trees. This is the sense in which we have defined assumptions 1. and 2., mentioned above, in Relations task #1 as well as in other cognitive tasks.

Obtained scores may further be interpreted (assumption #3) in terms of substages implying different cognitive structures as follows:

Stage I. (Child is unable to seriate)	Score
a. The child does not recognize differences in size of trees	0
b. The child understands big/small but does not attempt to make a series.	1-2

Stage II. (Transitional)

a. Child makes short discrete series of 2-3 trees or a continuous series of trees 3-4

b. Child seriates seven trees with trial and error (Changes the position of three or more trees) 5

State III. (Child seriates with one variable)

a. Child seriates seven trees spontaneously (Changes positions of one or two trees only). 6

Thus from differential behaviors implied by Stage 1, 2 or 3, different levels of cognitive structure for seriation may be inferred (assumption #3).

Also, Relations tasks, 1 through 6, are arranged in the theory-derived order of difficulty--Relations task #1, the easiest, to Relations task #6, the most difficult. It is reasonable to assume that a child who cannot seriate seven trees (Relations task #1) is unable to perform double seriation with seven trees and seven pots (Relations task #2). Therefore, Relations task #2 requires a higher order structure which coordinates and subsumes the one required for Relations task #1. This is the sense in which we have used the fourth assumption stated above in Relations and in all of the other Tasks of the NEWCAB.

The following tasks from the NEWCAB were administered to 3-5 year olds.

1. Single Seriation/Relations Task #1/RT_1 is designed to measure how a child seriates with one variable. This is a simple seriation task using seven green trees (cardboard cones) graduated in height to be placed in a row from the smallest to the largest. (Score = 0-6)
2. Double Seriation/Relations Task #2/RT_2 is designed to measure how the child seriates with two variables. Seven green trees (cardboard cones) used for RT_1 and seven brown pots (cardboard boxes) graduated in size are to be seriated making an ascending row of trees and a corresponding row of pots in front of the trees. (Score = 0-4)
3. Classification Task #1 (CT_1) Classification involves the conceptualization that objects can be grouped according to some criterion, that subclasses can be combined to form superordinate classes and that subclasses can stand in an inclusion relationship with superordinate classes. The purposes of CT#1 is to assess the child's ability to classify in two ways: 1) spontaneous sorting according to the child's freely chosen criterion,

and 2) specified sorting according to a criterion specified by the examiner.

Twenty-four 4x6 cards with shapes varying on the dimension of color (red or blue), shape (square or circle), and number (one or two objects) per card were used. (Score = 0-4)

4. Number-Length Task #1 (NLT#1) This task measures the child's understanding that the number of objects remains the same regardless of changes in arrangement. Seven cardboard trees and pots of the same size were used for this. (Score = 0-8)

Data Collection

All tests were individually administered in the same order: RT_1, RT_2, CT_1 and NLT_1. It took approximately 20-30 minutes to administer the tests depending upon the child's response style (deliberate, slow or quick). No time limits were imposed on any child. The interviewer was able to exercise judgment in allowing for breaks during testing. The same tests were administered at intervals of one year.

Findings

The data were subjected to ANOVA to check for developmental progress across three years and to investigate any repeated test effects. The construct validity (with theoretical assumptions 1, 2, and 3) for 3-5 year olds was examined by analyzing the mean performance scores and concept attainment across three years; and theoretical assumption #4

was verified through principal factor analysis with varimax rotation. Criterion related validity was checked by correlating the NEWCAB scores with PPVT-IQ.

Insert Table 2 About Here

Table 2 shows the mean scores of 3-5 year olds on the four tasks. The mean performance improved significantly across three years. For example, at age 3, 4, and 5 years the means of RT_1 were 2.76, 4.25, and 5.26; of RT_2, .28, 2.40, and 3.5; of CT_1, .50, 1.54, 2.47; and of NLT_1, 1.43, 2.77, and 5.22 respectively. Interpreting the mean scores on RT_1 in terms of substages as implied by assumption #3 (p. 6, 7-8) we find that the progression is from Stage IIa ($X = 2.76$) to Stage IIb ($X = 4.25$) to Stage III ($X = 5.26$). Performance on other variables could be interpreted similarly. The cognitive performance of children had improved with age.

Another way of looking at the cognitive changes with age is to examine the percentage of children who attained a particular concept across three years.

Insert Table 3 About Here

Table 3 shows the pass percentages on RT_1, RT_2, CT_1, NLT_1 for 3-, 4-, and 5-year olds. For example, at age 3, 12.5% of the children had attained the concept assessed by RT_1, but

40.4% had attained it by age 4 and about 80% by age 5. Similar increments hold for other variables.

Insert Figure 1 About Here

Figure 1 further illustrates graphically the same point, that, the cognitive performance improved with age and that cognitive changes proceeded in an orderly sequence. These data lend empirical support for some of the theoretical assumptions of the construct validity of NEWCAB.

Using the a priori criterion three factors, corresponding with the logical structures of Seriation, Classification, and Number, were specified in a principal factor procedure with a varimax rotation. No more than two factors could be extracted because of negative eigenvalues. For the variable factor identification a cut off value of $\pm.30$ for the loading of variables with a factor was established. This confirmatory factor analytic procedure was used for analyzing the Nebraska data for the 3-, 4-, and 5-year olds.

Insert Table 4 About Here

For the 3-year olds the varimax rotation showed a two factor solution accounting for 67.6 and 32.3 percent respectively of the common variance associated with the variables. RT_1 and RT_2 had loadings of -.66 and .69 respectively on factor 1; and

CT_1 and NLT_1 had loadings of .38 and .49 respectively on factor 2. These two factors accounted for 35% of total variance.

Insert Table 5 About Here

The same factor analytic procedures were used on the data for the 4-year olds. The varimax rotation of initial principal factor matrix showed two factors which explained 58.5% and 41.5% respectively of the common variance. RT_1 and RT_2 had loadings of -.71 and .75 on factor 1; RT_1, CT_1, and NLT_1 had loadings of .49, .54 and .50 respectively on factor 2. RT_1 cross loaded on both factors. These two factors explained 48.8% of total variance.

Insert Table 6 About Here

For the 5-year olds the varimax rotated factor matrix identified two factors explaining 65.3% and 34.1% respectively of common variance associated with the variables. RT_1 and RT_2 had loadings of -.71 and .76 on factor 1; RT_1, CT_1, and NLT_1 had loadings of .47, .45 and .36 respectively on factor 2. RT_1 cross loaded on both factors. About 43% of total variance is represented by the information contained in the factor matrix of Table 6.

Discussion

The logical structure of four tasks, RT_1, RT_2, CT_1, and NLT_1, could be redefined in terms of two factors instead of three as initially specified. RT_1 and RT_2 have significant positive as well as negative loadings on factor 1. For example, for the 3-year olds, these factor loadings are -.66 and .69; for the 4-year olds, the factor loadings are -.71 and .75; and for the 5-year olds these are -.71 and .76. Why are these loadings positive and negative if both RT_1 and RT_2 assess seriation ability? To interpret this one has to examine the scoring and administration procedures of the two tasks. RT_1, seriating with seven trees, is easier than RT_2 which required seriating with seven trees along with seriating seven corresponding pots. RT_1 requires seriating with one set of elements, whereas, RT_2 requires seriating with two sets of elements. According to the NEWCAB Manual children are administered RT_2 only if they succeed on RT_1. Thus high scores on RT_1 do not necessarily imply high scores on RT_2. Children scoring high on RT_1, if administered RT_2, will obtain low scores on it because it is somewhat more difficult and complex. The important consideration, however, is that both RT_1 and RT_2 have significant loadings on factor 1. Since these two tasks assess how a child seriates with one/two sets of objects in an ascending/descending order, factor 1 could be labelled as Seriation factor in the Piagetian sense.

Three of the four tasks--RT_1, CT_1 and NLT_1 loaded on factor 2. RT_1 cross loaded on both factors. This factor 2 could be interpreted as a general cognitive factor underlying Relations, Classification, and Number tasks. The cognitive structures of preoperational children pertaining to the logical operations of Relations, Classification and Number are still in the process of being formed. The cognitive structure is not clearly and precisely identifiable in the early stages. The second factor could be left "undefined" or could be labelled as a general cognitive factor underlying three logical operations.

To conclude, confirmatory factor analysis, provided adequate empirical evidence in support of the construct validity of NEWCAB for the preschool children.

Criterion related validity was checked by correlating RT_1, RT_2, CT_1, and NLT_1 with PPVT-IQ. For the 4-year olds correlations with RT_1, CT_1 and NLT_1 were .58, .24, .21, significant at .05 level.

For the 5-year olds the correlations of PPVT-IQ with RT_1 was .18 ($p<.10$); with RT_2, .36 ($p<.05$); with CT_1, .33 ($p<.01$); and with NLT_1, .29 ($p<.01$).

To conclude: the NEWCAB tasks have validity for assessing the cognitive development of preschool children.

References

Kalyan Masih, V., Marshall, W. H., Tomes, R., and Kastle R. Nebraska Wisconsin Cognitive Assessment Battery, pp. 233-392. Life Span Analysis of the Mental and Social Development of Rural Children. Technical Manual, Vol. I, North Central Regional Publication Number 285, 1985.

Table 1

Distribution of the Nebraska Sample by Age of Child, Year of Entering the Study and Continuity in the Study

	Year of Assessment		
	Year 1	Year 2	Year 3
Year 1	3(N=40)	4(N=36)	5(N=34)
Year 2		4(N=21)	5(N=20)
Year 3			5(N=20)
Total	40	57	74

Underlined entries represent approximate mean ages. Arrows indicate continuity of subgroups.

Table 2

Mean Scores of 3-, 4-, 5-Year Olds
on All Variables

Task	Score Range	Number of Children and Average Scores Year 1		Year 2		Year 3	
		N	Age 3	N	Age 4	N	Age 5
Relations #1	0-6	40	2.76	57	4.25	74	5.26
Relations #2	0-4	11	.28	23	2.40	59	3.54
Classification #1	0-4	40	.50	57	1.54	74	2.47
Number-Length #1	0-8	40	1.43	57	2.77	74	5.22

Average scores are based on the number of children who took the test. Children were not given next higher level tests if they did not pass easier tests within a section.

Table 3

Percentage of Children
Attaining the Concept

	Age 3	Age 4	Age 5
RT#1	12.5%	40.4%	79.7%
RT#2	0.0%	17.5%	66.2%
CT#1	0.0%	21.1%	44.4%
NLT#1	7.5%	33.3%	68.9%

Table 4

Varimax Rotated (Common Factor Analysis)
Factor Matrix: 3 Year Olds

Nebraska, N=34

Variables	Factor 1	Factor 2	Commonality
RT_1	-.66	.29	.52
RT_2	.69	.03	.47
CT_1	-.17	.38	.18
NLT_1	.02	.49	.22
Eigenvalue	.94	.45	1.39
Percent of common variance	67.6	32.3	
Percent of total variance	23.5	11.3	
Cum. per. of total variance	23.5	34.8	

Table 5

Varimax Rotated (Common Factor Analysis)
Factor Matrix: 4 Year Olds

Nebraska, N=54

Variables	Factor 1	Factor 2	Commonality
RT_1	-.71	.49	.75
RT_2	.75	-.17	.60
CT_1	-.21	.54	.33
NLT_1	-.13	.50	.27
Eigenvalue	1.14	.81	1.95
Percent of common variance	58.5	41.5	
Percent of total variance	28.5	20.3	
Cum. per. of total variance	28.5	48.8	

Table 6
Varimax Rotated (Common Factor Analysis)
Factor Matrix: 5 Year Olds

Nebraska, N=73

Variables	Factor 1	Factor 2	Commonality
RT_1	-.71	.47	.73
RT_2	.76	-.21	.62
CT_1	-.14	.45	.23
NLT_1	-.15	.36	.15
Eigenvalue	1.13	.59	1.73
Percent of common variance	65.3	34.1	
Percent of total variance	28.3	14.8	
Cum. per. of total variance	28.3	43.1	